Web Availability of MACHO Data

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ABSTRACT

The MACHO Project generated two-color photometric lightcurves for 73 million stars in the LMC, SMC, and the galactic bulge during its 8 years of observing. This photometry, along with all images and a catalog of LMC variable stars, is now available for viewing or download from the MACHO Project websites, http://wwwmacho.anu.edu.au or http://wwwmacho.mcmaster.ca. The capabilities and organization of the new data retrieval facility is described in this paper.

1. Introduction

The MACHO Project (Alcock et al. 2000) had as its principal goal the detection of gravitational microlensing in the LMC, with the SMC and Galactic bulge as secondary targets. The 1.3m Great Melbourne Telescope at Mt. Stromlo Observatory was used for the observations, with a ccd mosaic camera containing 8 2k x 2k chips supplying images in two passbands simultaneously. Observations began in 1992, and terminated in 2000. Approximately 8TB of image data were collected, and photometric lightcurves constructed for about $7.3 * 10^7$ stars.

All MACHO images and lightcurves, and a catalog of LMC periodic variable stars, are now publicly available from the MACHO project website,
http://wwwmacho.anu.edu.au/Data/MachoData.html or
http://wwwmacho.mcmaster.ca/Data/MachoData.html. The MACHO data archive is housed on a mass storage system at the ANU Supercomputer Facility. The storage hardware is a robotic tape silo, fronted by a large disk cache. Access times vary from near zero if data is cached, to several minutes if data must be fetched from tape. Users should be aware that

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the data they request will be delivered from the data archive in Australia regardless of which web site they utilize.

The following sections of the paper briefly describe the data that is now available and the nature of the web interface that is provided to it. More detailed information is available from the help sections provided on the website.

2. Image Access

Images can be selected in several ways. If only a representative image of a field is required, the best choice is probably the "Template Image Download" interface. Template images form the base of Macho photometry and astrometry, and have been selected to have good seeing and dark sky conditions. The "Macho Image Search" interface provides a flexible method of locating images of interest. Selection criteria can include position, date of observation, seeing, airmass, and sky brightness. Finally, the "Image Download" interface is for situations where the desired observation id's are already known.

3. LightCurve Access

The Macho photometry data is internally organized as lightcurves. A lightcurve contains all available data in both passbands for a given star. At each time point several quantities are available in addition to the two instrumental magnitudes. These include the estimated errors, flags that indicate possible problems with the particular data point, and information about the observation that generated the data.

At present, the stars for which lightcurves are desired must be specified by their Macho field.tile.sequence identifier. This allows easy access to lightcurves which have appeared in published papers, but is not useful for searches, eg for objects near some particular position. As discussed in the last section of this paper, an enhanced search capability will be provided shortly.

Once selected, lightcurves can either be viewed interactively, or downloaded to the user's computer. The interactive viewer provides capabilities to zoom in or out, and to access details of individual lightcurve points.

4. Variable Star Catalog

The variable star catalog contains about 21000 stars from the LMC. These stars have been phased and classified, and the catalog contains a variety of quantities of interest. Stars may be selected based on their catalog parameters, and phased or unphased lightcurves displayed. A paper presenting the variable star catalog is in preparation (Alcock et al. 2001).

5. Future Enhancements

A number of enhancements to the Macho data access site are planned for the near future:

- RA/Dec selection of stars: The need to access lightcurves by field.tile.sequence will be removed with a new interface that allows selection of stars based on RA/Dec coordinates.
- GLU: A GLU interface will be provided, so that external websites, such as CDS, will be able to easily incorporate Macho data.
- Mirrors: We plan to set up mirror sites in North America for the data, which is currently available only from Australia.
- Improved image format: Image data is currently returned as 16 separate FITS files, one for each amplifier in the CCD mosaic. We are planning to bundle these into a single multi-extension FITS file, and include WCS data in the header which will allow any pixel in the image to be mapped to RA/Dec with sub-arcsecond precision.

REFERENCES

Alcock, C., et al. 2000, ApJ, 542, 281

Alcock, C., et al. 2001, in preparation